Space Weather Technical Forecast

Issued on Sunday, 30 June 2024 at 13:08 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares throughout. Chance of G1/Minor Storm intervals Day 1 (30 Jun) and again Days 3-4 (02-03 Jul).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: There are currently fifteen regions on the disc, most of which are small and simple. The largest region remains AR3719 in the southwest quadrant, followed by AR3727 approaching south centre disc and AR3729 in the southeastern quadrant. AR3719 seems to be mature and largely inactive, as does AR3727. AR3729 has seen growth of its intermediate spots. AR3733 to the north of this has shown growth of the trailing penumbra, but lost some intermediate spots. AR3734, which has recently rotated onto the eastern limb, is starting to show some intermediate spots and may continue to alter as it becomes more clearly visible. There appears to be magnetic interaction between many of these regions, especially those close together in the south of the disc.

A large filament in the southwest was observed lifting off from the Sun's surface around 29/1530 UTC, with a subsequent CME observed in coronagraph imagery. Analysis suggests this could give a glancing blow at Earth on Days 3 or 4 (02-03 Jul).

Solar Wind / Geomagnetic Activity: Solar winds observed by ACE and DSCOVR at L1 are still showing weak CME effects after the arrival on 28 Jun. Wind speeds have been slightly elevated, between 380-500 km/s, but with a slight rising trend recently. Density has been average or below. The Interplanetary Magnetic Field, Bt, was initially moderate, peaking at 10nT, but has eased to become weak. The north-south component, Bz, has varied throughout the period, occasionally moderately, between +9/-8nT. Phi angle has been predominantly positive (away from the Sun). Geomagnetic activity has been Quiet to Unsettled (Kp2-3).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES18 remained at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at background levels. The 24-hour fluence remained below Active, with 1.03e6 integrated pfu observed at 30/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low activity is likely to continue, with a chance of isolated M-flares.

Solar Wind / Geomagnetic Activity: Effects from the CME that arrived at Earth on 28/0910 UTC have continued to wane. However, there is the potential for a further weak CME arrival on Day 1 (30 Jun). A large CME was observed in the southwest from a filament liftoff around 29/1530 UTC, with a glancing blow likely either on Day 3 or Day 4 (02-03 Jul). There are significant uncertainties in the timing of both features, however. There are no significant coronal holes on the disc to give any fast wind influence.

Geomagnetic activity is expected to be generally Quiet to Unsettled (Kp1-3), with a chance of Active to G1/Minor storm intervals (Kp4-5) on Day 1 and again on Days 3-4 under CME influence, however confidence is fairly low.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at background levels. However, there is a very slight chance of exceeding the S1/Minor Storm threshold should any notable flares occur. High energy electron flux might show an increasing trend in the next few days after the recent CME influence. The associated 24-hour fluence is

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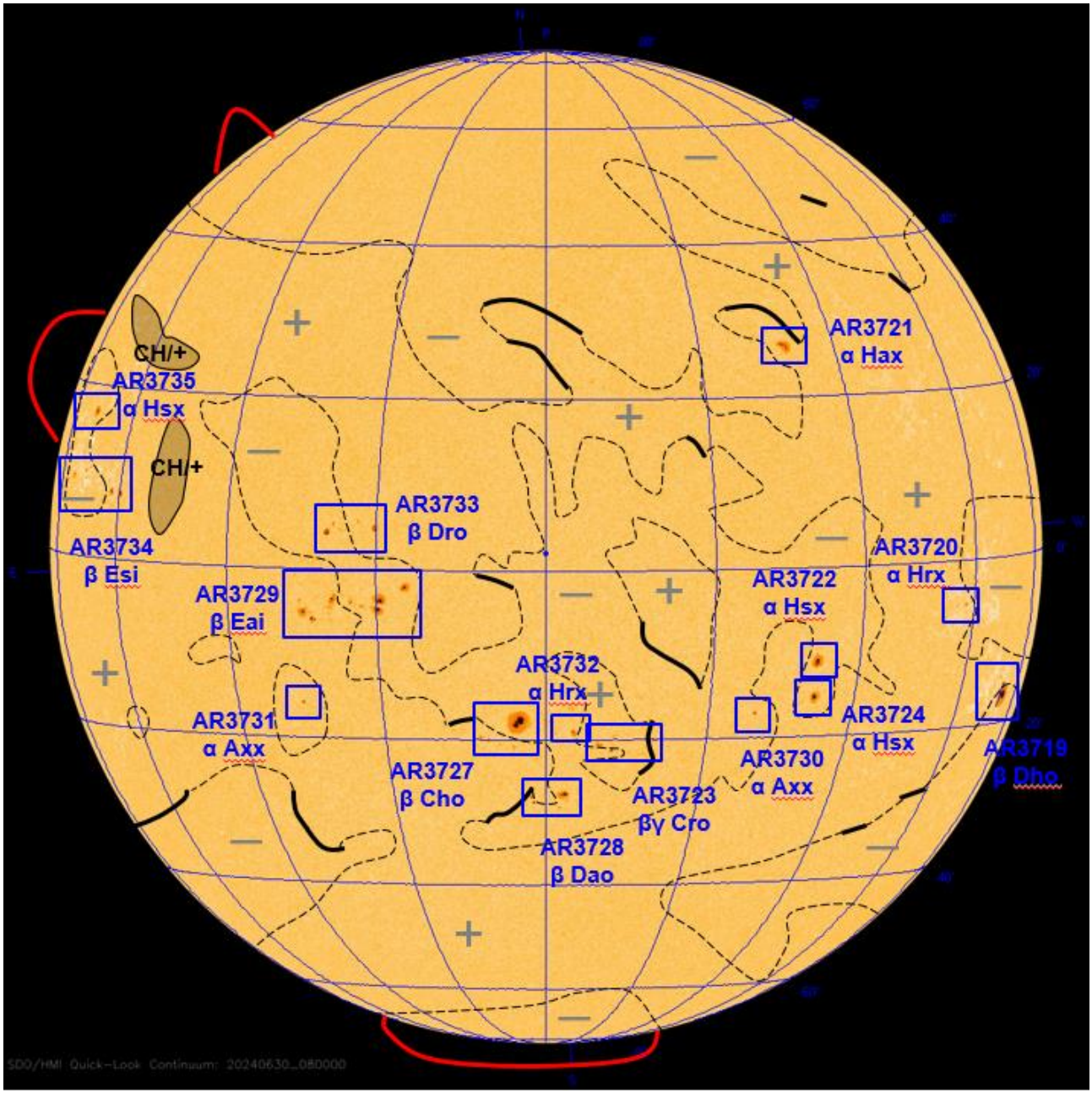
likely to remain below the Active threshold however, with a slight chance of exceeding later in the period.

Figure 1. Solar Analysis Valid 30/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Effects from the CME that arrived at Earth on 28/0910 UTC have continued to wane. However, there is the potential for a further weak CME arrival on Day 1 (30 Jun) but confidence is low. A large filament liftoff was observed around 29/1530 UTC in the southwest, with a resulting large CME observed leaving the Sun in coronagraph imagery. Analysis suggests a glancing blow either on Day 3 or Day 4 (02-03 Jul) with the bulk of the ejecta passing below Earths orbit. There are significant uncertainties in the timing of both features, however.

There are no significant coronal holes on the disc to give any fast wind influence.

Geomagnetic activity is expected to be generally Quiet to Unsettled (Kp1-3), with a chance of Active to G1/Minor storm intervals (Kp4-5) on Day 1 and again on Days 3-4 under CME influence, however confidence is fairly low.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	5	30	30
Strong	G3	No	1	1	5	5
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
28/0200	Partial	AR3719	SW	390 km/s	30/0600 UTC +/- 9 hrs	Glancing blow possible.
29/2010	Partial	Filament	SW	780 km/s	03/0000 UTC +/- 12 hrs	Glancing blow likely. Timing uncertain.

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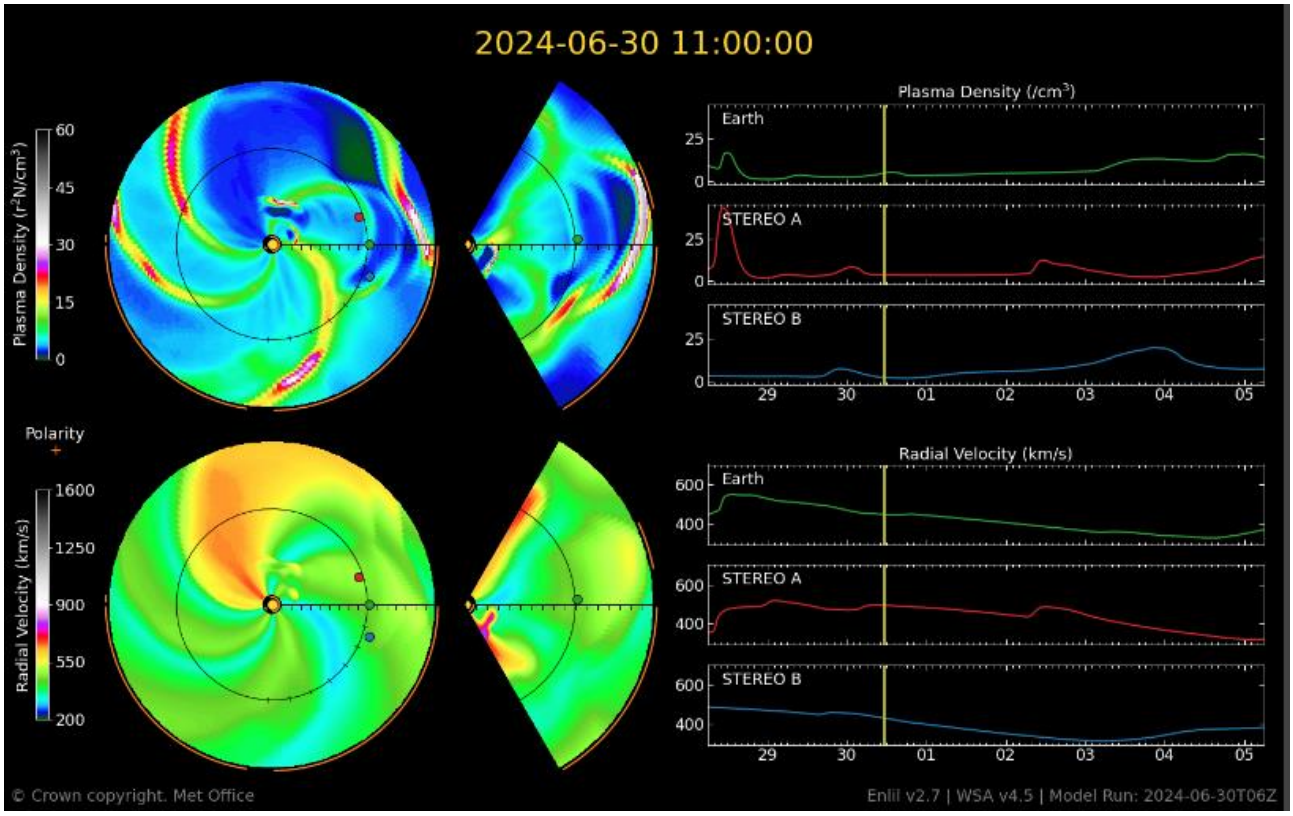
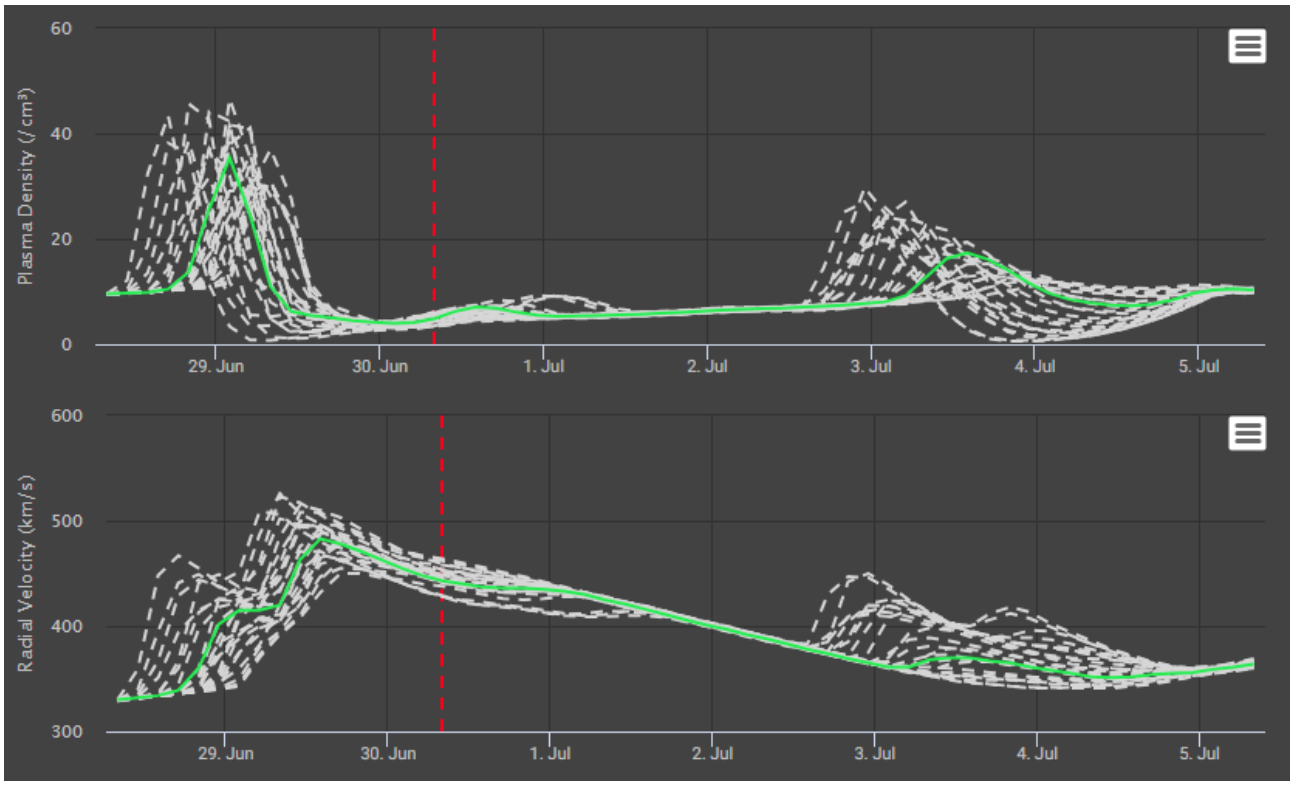
Figure 2: MOSWOC Enlil and ensemble showing potential CME arrivals today and 02-03 July.





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Radio Blackouts - X-Ray Flares:
There are currently fifteen regions on the disc, most of which are small and simple. The largest region remains AR3719 (Dho/Beta) in the southwest quadrant, followed by AR3727 (Cho/Beta) approaching south centre disc and AR3729 (Eai/Beta) in the southeastern quadrant. AR3719 seems to be mature and largely inactive, as does AR3727. AR3729 has seen growth of its intermediate spots. AR3733 (Dro/Beta) to the north of this has shown growth of the trailing penumbra, but lost some intermediate spots. AR3734 (Esi/Beta), which has recently rotated onto the eastern limb, is starting to show some intermediate spots and may continue to alter as it becomes more clearly visible. There appears to be magnetic interaction between many of these regions, especially those close together in the south of the disc.

AR3719 rotates off on Day 2 (01 Jul) and AR3720 on Day 3 (02 Jul), however each individual region only contributes a small amount to the overall flare risk. Overall, the flare risk has been kept flat throughout with a chance of isolated M-class flares, and a very slight chance of X-class flares.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 M Class**	No	40	40	40	40
Very Active	**R3 to R5 X Class**	No	5	5	5	5

Figure 3: X-ray flux at GOES16 and 18 showing only C-class flares in the last 24 hours.

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Solar Radiation Storms - (High Energy Protons):
High energy proton flux, as measured by GOES-18, is most likely to remain at background levels. Despite a large amount of sunspots on the Earth-facing disc, they are relatively small and magnetically simple, making proton enhancements unlikely.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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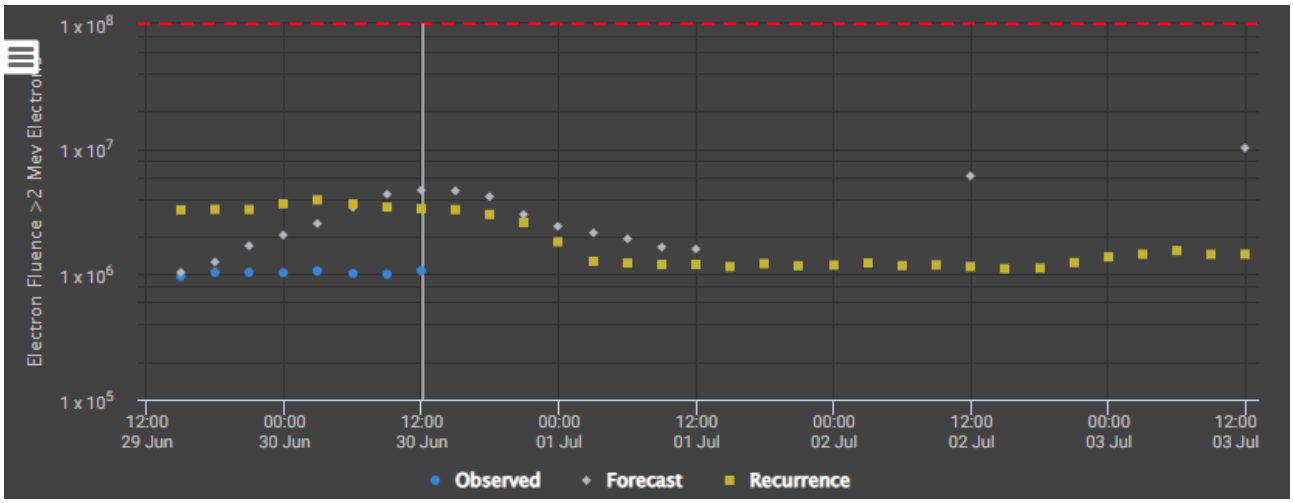
High Energy Electrons Event (≥ 2MeV):
High energy electron flux, as observed by GOES-16, is expected to continue at background levels for the start of the period. The recent CME enhancement may have caused an increase in electron flux below GEO, but the potential for further CME arrivals could suppress this once again. Overall, electron flux is most likely to stay at background levels, but as the solar wind speeds decline there is the possibility of an increase to peak at moderate or perhaps high levels later in the period.

Associated electron fluence is most likely to persist below the Active threshold (1e8 integrated pfu), but with a slight chance of an increase above Active later in the period. MOSWOC REFM is forecasting a below Active trend through the next three days, which reflects the most probable outcome.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	10	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: MOSWOC REFM showing a below Active forecast, which seems like good guidance.



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